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Acute respiratory tract infections among Hajj medical mission personnel, Saudi Arabia

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Summary
Objectives: To estimate the prevalence of acute respiratory tract infections (ARI) among 250 personnel serving in a Hajj medical mission, Al-Hada and Taif Armed Forces Hospitals, during the 2005 season and to determine the effectiveness of protective measures, including influenza vaccination, for these infections.
Methods: This was a nested case-control study. A questionnaire was distributed to the study cohort two weeks after the Hajj period and was self-administered by all recruited subjects. In addition, the medical records of study subjects were reviewed at Al-Hada Hospital for the same period in order to document ARI.
Results: The attack rate for ARI among study subjects during Hajj season or within two weeks of returning was 25.6% (64/250). Logistic regression analysis of factors related to acquiring ARI revealed that contact with pilgrims imposed an extremely high risk of infection (adjusted OR 13.2, 95% CI 1.5—117.6). Moreover, non-use of alcohol-based hand disinfection carried a more than 8-fold risk of acquiring ARI compared to those who always used alcohol for hand disinfection (adjusted OR 8.4, 95% CI 2.2—32.2). Smoking was also a predictor of ARI in our cohort and influenza vaccination was associated with a 30% reduction in ARI compared to unvaccinated subjects, although this finding was not statistically significant. Unexpectedly, the logistic regression model showed that Saudi nationals were three times more likely to acquire ARI than non-Saudis (adjusted OR 3.1, 95% CI 1.2—8.4).
Conclusions: The common practice among pilgrims and medical personnel of using surgical facemasks to protect themselves against ARI should be discontinued and regular use of alcohol-based hand scrubs should be more vigorously encouraged. Further research is needed to evaluate the protective value of N95 facemasks against ARI during the Hajj period.

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Introduction

Influenza virus is a common respiratory agent that often requires outpatient healthcare visits or hospitalization. Influenza rapidly spreads around the world in seasonal epidemics and imposes a considerable economic burden in the form of hospital and other healthcare costs and lost productivity. Recent studies have shown a high incidence of influenza infections during the Muslim Hajj pilgrimage to Mecca, Saudi Arabia.[1,2] Hajj is the largest annual gathering of its kind in the world that brings over two million people together in a small, geographically-confined area. All adult Muslims who are physically and financially able to do so, have a religious obligation to make the pilgrimage once in their lifetime and over two million from around the world gather in Mecca each year.[3] Around 41 091 pilgrims from Europe attended the 2005 Hajj season.[4]

Attack rates vary during outbreak cycles of influenza but have been reported as high as 20–40% during the peak period of activity.[5] Information regarding the magnitude of ARI during Hajj season is generally lacking, which hinders efforts for prevention and control. One study has reported a cumulative incidence of ARI of 40% among a group of pilgrims, coinciding with the above-mentioned attack rate for influenza during pandemics.[6]

Although a number of non-immunization and non-pharmacologic interventions like personal hygiene, the wearing of facemasks, and screening and quarantine of travelers to slow international spread were tested during the emergency global response to severe acute respiratory syndrome (SARS), their use during the differing conditions of an influenza pandemic has not been systematically evaluated.[7] This study was conducted to estimate the prevalence of ARI among personnel serving in two Hajj mission hospitals in Saudi Arabia during the 2004 season, as well as to determine the effectiveness of protective measures against ARI.

Patients and methods

This was a nested case-control study. Study subjects included all Hajj mission members of the Al-Hada and Taif Military Hospitals for the year 2005 (a total of 375 individuals). Subjects with chronic obstructive lung disease and bronchial asthma or those who did not complete one week working for the mission were excluded from the study (28 members). A response rate of 250/347 (72.0%) was obtained.

A questionnaire was distributed to the study cohort two weeks after the Hajj period and was self-administered by all recruited subjects. Items contained in the questionnaire included history of ARI during or within two weeks of returning from Hajj, possible risk factors for ARI such as smoking, and influenza vaccination history. Both Arabic and English versions of the questionnaire were distributed. In addition the medical records of study subjects were reviewed at Al-Hada Hospital for the same period in order to document ARI.

Respiratory tract infection was considered in any person suffering from at least one constitutional symptom (fever, headache, and myalgia) plus at least one of the following local symptoms (coryza, sneezing, throat pain, cough with/without sputum, and difficulty breathing).[8]

Informed consent was provided by all subjects, and approval from the Ethical Review Committee of both hospitals was also obtained.

Statistical analysis

Analysis of data was performed using the SPSS version 11 statistical package. All variables were treated as categorical variables. Bivariate and multivariate logistic regression analyses were done to calculate crude and adjusted odds ratios and their 95% confidence intervals for studied risk factors of respiratory tract infection. Chi-square for trend analysis was performed where appropriate.

Results

Mean patient age was 37 years ±8.7. The male to female ratio was approximately 7:1. About one-half of participants were employees (non-medical staff). Saudi nationals represented 48.8% of the study subjects (Table 1). The attack rate for ARI among members of the mission during Hajj season or within two weeks of returning was estimated as 25.6% (64/250).

Table 2 and Figure 1, show that 36.1% of Saudi mission members had ARI compared to 15.6% of non-Saudi staff, representing a 3-fold higher risk for Saudi nationals (OR 3.1, 95% CI 1.6–5.8). Subjects over 45 years of age were 91% less likely to contract ARI compared to the youngest age group (≤30 years old) (OR 0.09, 95% CI 0.02–0.4). There was a trend showing the overall risk of developing ARI decreasing with advancing age (χ^2 for trend = 11.6, $p = 0.001$). Furthermore, smokers were found to have 2.5-fold greater risk of developing ARI compared to non-smokers (OR 2.5, 95% CI 1.02–6.2).

Table 1 Demographic characteristics of Hajj mission workers ($N = 250$), Saudi Arabia

Variable	*n* (%)
Sex	
Male	218 (87.2)
Female	32 (12.8)
Occupation	
Physician	42 (16.8)
Nurse	22 (8.8)
Military staff	34 (13.6)
Employee	126 (50.4)
Technician	26 (10.4)
Nationality	
Saudi	122 (48.8)
Non-Saudi	128 (51.2)
Age group	
≤30 years	70 (28.0)
31–45 years	134 (53.6)
>45 years	46 (18.4)
Mean age	37
SD	±8.73
95% CI	36.41–38.04

SD, standard deviation; 95% CI, 95% confidence interval.

Table 2 Predictors of acute respiratory tract infections (ARI) among Hajj mission workers, Saudi Arabia

	Having ARI during Hajj time or within two weeks of return		OR (95% CI)
	No (N = 186) n (%)	Yes (N = 64) n (%)	
Sex			
Male[a]	162 (74.3)	56 (25.7)	1.0
Female	24 (75)	8 (25)	0.96 (0.3—3.2)
Nationality			
Non-Saudi[a]	108 (84.4)	20 (15.6)	1.0
Saudi	78 (63.9)	44 (36.1)	3.1 (1.6—5.8)
Age group			
≤30 years	46 (65.7)	24 (34.3)	1.0
31—45 years	96 (71.6)	38 (28.4)	0.8 (0.4—1.4)
>45 years	44 (95.7)	2 (4.3)	0.09 (0.02—0.4)
χ^2 for trend = 11.6 p = 0.001			
Occupation			
Physicians[a]	30 (71.4)	12 (28.6)	1.0
Nurses	16 (72.7)	6 (27.3)	0.9 (0.3—3.4)
Military staff	18 (52.9)	16 (47.1)	2.2 (0.8—6.4)
Employees	96 (76.2)	30 (23.8)	0.8 (0.3—1.9)
Technicians	26 (100)	—	NS
Smoking			
No[a]	154 (78.6)	42 (21.4)	1.0
Yes	32 (59.3)	22 (40.7)	2.5 (1.02—6.2)
Direct contact with pilgrims			
No	52 (96.3)	2 (3.7)	1.0
Yes	134 (68.4)	62 (31.6)	12.0 (1.6—92.7)
Influenza vaccination			
Yes[a] (>2 weeks)	74 (72.5)	28 (27.5)	1.0
Yes (<2 weeks)	36 (69.2)	16 (30.8)	1.2 (0.5—2.6)
Not immunized	76 (79.2)	20 (20.8)	0.7 (0.3—1.4)
Using facemask during work			
Yes[a]	92 (83.6)	18 (16.4)	1.0
Intermittently	80 (65.6)	42 (34.4)	2.7 (1.4—5.0)
Non-use	14 (77.8)	4 (22.2)	1.5 (0.4—5.6)
Using alcohol for hand disinfection			
Yes[a]	76 (86.4)	12 (13.6)	1.0
Intermittently	70 (77.8)	20 (22.2)	1.8 (0.8—4.3)
Non-use	40 (55.6)	32 (44.4)	5.1 (2.2—11.8)
χ^2 for trend = 19.1, $p < 0.001$			

[a] Reference category. OR, odds ratio; 95% CI, 95% confidence interval. NS, not significant.

Direct contact with pilgrims during healthcare services carried an extremely high risk of acquiring ARI (OR 12.0, 95% CI 1.6—92.7). No statistically significant association was found between ARI and occupation or vaccination against influenza (either more than two weeks or less than two weeks or not immunized at all). Using facemasks intermittently carried more risk of acquiring ARI than using facemasks all the time (OR 2.7, 95% CI 1.4—5.0). Medical personnel who never used alcohol for hand disinfection developed ARI five times more often compared to those who practiced regular alcohol hand disinfection (OR 5.1, 95% CI 2.2—11.8). In addition, there was a statistically significant negative trend for alcohol use in hand disinfection. Alcohol use for hand disinfection was found to be protective against ARI comparing those who regularly used alcohol to those who used alcohol intermittently (with nearly double the risk), and to those who never used alcohol (with nearly five times the risk) (χ^2 for trend = 19.1, $p < 0.001$).

Logistic regression analysis of factors related to acquiring ARI revealed that contact with pilgrims imposed a very high risk of infection (adjusted OR 13.2, 95% CI 1.5—117.6) (Table 3). Moreover, never using alcohol for hand disinfection carried more than eight times the risk of acquiring ARI compared to those who always used alcohol for hand disinfection (adjusted OR 8.4, 95% CI 2.2—32.3). Unexpectedly, the logistic regression model showed that Saudis were three

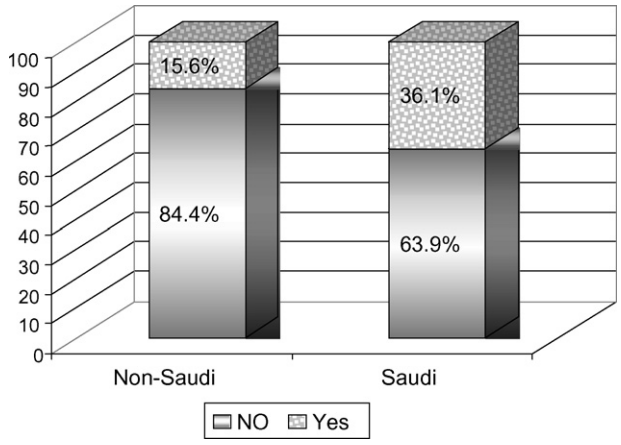

Figure 1 Hajj mission personnel having RTI during Hajj time or two weeks after.

Table 3 Logistic regression analysis of selected risk factors for ARI among Hajj mission personnel, Saudi Arabia

	Beta	*p*	Adjusted OR	95% CI
Direct contact with pilgrims	2.580	0.021	13.2	1.5—117.6
Using alcohol for hand disinfection				
Yes[a]		0.006	1.0	
Intermittently	0.571	0.351	1.8	0.5—5.9
Never	2.126	0.002	8.4	2.2—32.3
Saudi nationality	1.139	0.024	3.1	1.2—8.4
Age group				
≤30 years[a]		0.033	1.0	
31—45 years	0.746	0.202	2.1	0.7—6.6
>45 years	2.263	0.052	0.1	0.01—1.02

[a] Reference category. OR, odds ratio; 95% CI, 95% confidence interval.

times more at risk of acquiring ARI compared to non-Saudis (adjusted OR 3.1, 95% CI 1.2—8.4).

Discussion

Acute respiratory tract infections represent a major problem during Hajj season and clearly effective interventions for control and prevention have not been demonstrated, unlike cholera and meningococcal meningitis, which have been successfully controlled by the Saudi health authority. With the hope of potentially helping the Saudi government design a rational control program for ARI during the Hajj season, the present study examined possible risk and protective factors for ARI among Hajj medical mission personnel.

We found the ARI attack rate (25.6%) among medical mission members in our Saudi hospitals within the range estimated by Conly and Johnston (20—40%) during influenza pandemics.[5] This figure is also consistent with the 39% incidence of ARI among pilgrims from Riyadh.[6] In another survey, 10.8% of 500 Hajj pilgrims presenting with upper respiratory tract symptoms had a positive viral throat culture.[1] Our finding that ARI were less frequent among older age groups is in contrast to the study by Khalid and coworkers.[6] A possible explanation for our results could be that the older age groups are usually higher-ranked officers or employees who are less involved in pilgrim care, while younger staff are more frequently in direct contact with pilgrims, and thus have greater exposure and risk of infection. Neither we nor Khalid and colleagues could determine an association between infection and gender.[6]

Unlike the above-mentioned report of ARI among Hajj pilgrims from Riyadh,[6] in our study regular use of facemasks offered no significant protection against ARI. Our finding is in agreement, however, with the conclusion of the Centers for Disease Control and Prevention (CDC) in the USA which stated that surgical masks are not designed for use as particulate respirators and do not provide much protection against airborne diseases because they do not effectively filter small particles from the air or prevent leakage around the edge of the mask when the user inhales.[9] Furthermore, we found that intermittent use of surgical-type masks was actually associated with more than a 2.5-fold greater risk of infection. It is possible that once a facemask is worn in the presence of an infected patient, the mask could become contaminated with infectious material and touching the outside of the device could result in hand transmission of the infection to the respiratory tract during nose-rubbing.[9]

We found cigarette smoking to be a strong predictor of ARI in our cohort, although previous reports regarding the association between smoking and respiratory infection, including influenza, have been conflicting.[6,10] The use of alcohol-based hand rub as an effective infection control measure against ARI has been recommended by the World Health Association (WHO).[11] We noted a 5-fold greater risk of infection among those who never used alcohol-based hand disinfection compared to regular users.

In our cohort, influenza vaccination was associated with a 30% reduction in ARI compared to unvaccinated subjects, although this finding was not statistically significant. WHO has estimated the effectiveness of influenza vaccine in the reduction of disease-related morbidity to be 60%.[12] Finally, there was a 3-fold higher risk of ARI among Saudi nationals than non-Saudis in our study population, and this unexpected finding was still significant after controlling for possible confounders. Further research is needed to confirm and clarify this association.

Limitations of our study included the small number of subjects and an incomplete analysis of habits related to respiratory facemask use such as frequency of mask changing and the covering of the face by women during hospital work. We intentionally tried to keep this initial questionnaire as concise as possible, but analysis of mask use patterns is a potential area of future investigation.

In conclusion, ARI were seen in one-quarter of the hospital worker population in two Saudi Hajj mission hospitals. Major risk factors for infection were direct contact with pilgrims, cigarette smoking, intermittent use of surgical facemasks, non-use of alcohol-based hand disinfection, and Saudi nationality. The common practice among pilgrims and medical personnel of using surgical facemasks to protect themselves against ARI should be discontinued. Instead, protective equipment such as N95 masks should be considered, although their protective efficacy has not been evaluated during

influenza epidemics. Regular use of alcohol-based hand scrubs should be more vigorously encouraged. Health awareness campaigns targeting pilgrims and healthcare workers should be established during Hajj period.

Conflict of interest: No conflict of interest to declare.

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